

## CLAIMS:

1. A leak detection apparatus comprising:
  - a power supply for supplying an electrical current;
  - a probe electrically connected to the power supply for receiving the electric current, the probe emitting the electric current to fluid in a fluid-filled vessel, and the probe sensing current density in the fluid to communicate an electrical signal; and
  - a current density meter electrically connected to the probe for receiving the electrical signal, the current density meter measuring the electrical signal to communicate a current density reading.
2. The leak detection apparatus of claim 1 wherein the probe comprises:
  - a handle;
  - a torroid affixed to an end of the handle;
  - a protective coating covering the handle and torroid for protection from corrosive fluids; and
  - a directional amplifier affixed to the handle for supplying electric current to the fluid-filled vessel.
3. The leak detection apparatus of claim 2 wherein the directional amplifier comprises a rod with a C-shaped end so that a tip of the C-shaped end is aligned with a centerline of the torroid at an effective distance.
4. The leak detection apparatus of claim 2 wherein the directional amplifier comprises a rod with a ball affixed to the end so that the center of the ball is aligned with the centerline of the torroid at an effective distance.

5. The leak detection apparatus of claim 2 wherein the directional amplifier comprises means for maximizing the reading of current density by the current density meter

6. The leak detection apparatus of claim 1 wherein the electric current supplied by the power supply is a DC current.

7. The leak detection apparatus of claim 1 wherein the electric current supplied by the power supply is an AC current.

8. A leak detection apparatus comprising:  
an integrated power supply and current density meter for supplying an electric current, and for receiving and measuring an electrical signal for communicating a current density reading; and

a probe electrically connected to the integrated power supply and current density meter for receiving electric current, the probe emitting electrical current to fluid of a fluid-filled vessel, and the probe sensing current density for communicating the electrical signal to the integrated power supply and current density meter.

9. The leak detection apparatus of claim 8 wherein the probe comprises:  
a handle;  
a torroid affixed to an end of the handle;  
a protective coating covering the handle and torroid for protection from corrosive fluids; and  
a directional amplifier affixed to the handle for supplying electric current to the fluid-filled vessel.

10. The leak detection apparatus of claim 8 wherein the directional amplifier comprises a rod with a C-shaped end so that a tip of the C-shaped end is aligned with a centerline of the torroid at an effective distance.

11. The leak detection apparatus of claim 8 wherein the directional amplifier comprises a rod with a ball affixed to the end so that the center of the ball is aligned with the centerline of the torroid at an effective distance.

12. The leak detection apparatus of claim 8 wherein the directional amplifier comprises means for maximizing the reading of current density by the current density meter when the probe is pointed at a crack.

13. The leak detection apparatus of claim 8 wherein the electric current supplied by the power supply is a DC current.

14. The leak detection apparatus of claim 8 wherein the electric current supplied by the power supply is an AC current.

15. A method of leak detection comprising the steps of:  
inserting a probe into a fluid filled vessel;  
communicating an electric current from a power supply to the probe;  
sensing a current density with the probe;  
communicating an electrical signal from the probe to a current density meter;  
measuring the electrical signal from the probe to determine a current density reading;  
communicating the current density reading to an operator.

16. A leak detection apparatus comprising:

a power supply for supplying an electrical current;

a directional amplifier electrically connected to the power supply for receiving the electric current, the directional amplifier emitting the electric current to fluid in a fluid-filled vessel;

a torroid for sensing current density in the fluid to communicate an electrical signal; and

a current density meter electrically connected to the torroid for receiving the electrical signal, the current density meter measuring the electrical signal to communicate a current density reading.

17. The leak detection apparatus of claim 16 further comprising:

a handle affixed to the torroid; and

a protective coating covering the handle and torroid for protection from corrosive fluids.

18. The leak detection apparatus of claim 16 wherein the directional amplifier comprises a rod with a ball affixed to the end.

19. The leak detection apparatus of claim 16 wherein the directional amplifier comprises means for minimizing the reading of current density by the current density meter when the torroid is perpendicular to a crack.

20. The leak detection apparatus of claim 16 wherein the electric current supplied by the power supply is a DC current.

21. The leak detection apparatus of claim 16 wherein the electric current supplied by the power supply is an AC current.

22. A method of leak detection comprising the steps of:

- inserting a directional amplifier into a fluid filled vessel;
- inserting a torroid into the fluid filled vessel;
- communicating an electric current from a power supply to the directional amplifier;
- sensing a current density with the torroid;
- communicating an electrical signal from the torroid to a current density meter;
- measuring the electrical signal from the torroid to determine a current density reading;
- communicating the current density reading to an operator.